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The Effects of Lipid Structure on Membrane Fluidity

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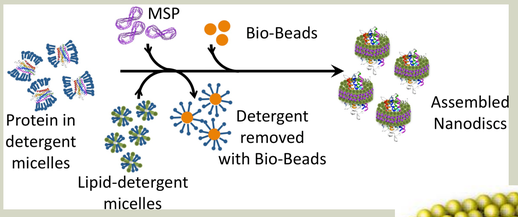
Introduction

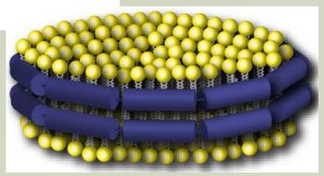
- Hypothesis: If we excite nanodiscs with different lipid compositions, specifically with differences in saturation, tail length and overall charge, then we would be able to examine the differences in membrane fluidity because the average lifetimes would reflect the relaxation rates.
- Nanodiscs are lipid bilayers surrounded by two identical membrane scaffold proteins, a derivative of apolipoprotein A1.
- Apolipoprotein A1 in the body carries cholesterol and phospholipids through the blood to be excreted by the liver. They are important in fat metabolism.
- We used nanodiscs to study membrane-protein interactions because they are a good model for the lipid-protein interactions in cells. We are using liposomes as a control because they do not have the scaffold protein creating pressure within the macromolecular complex.
- Lifetimes are the average time a fluorophore is in the excited state before releasing a photon and returning to the ground state.
- Intensity decay equation:

$$I(t) = \sum a_n e^{-\frac{t}{t_n}}$$

Making Nanodiscs



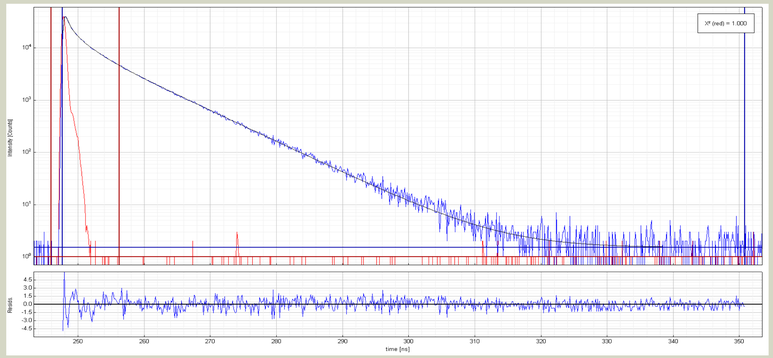
- Making liposomes is a similar process, except detergent and belt protein are omitted.

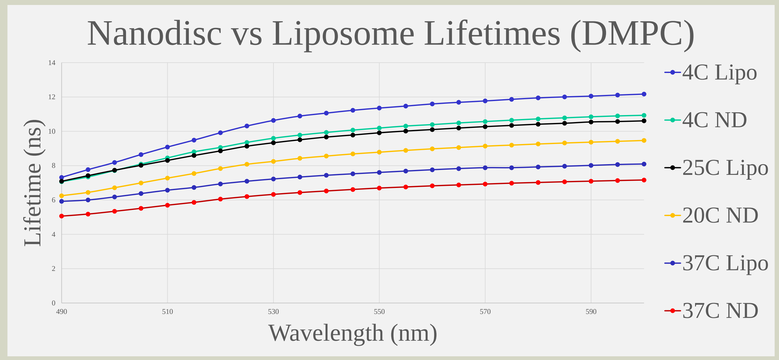


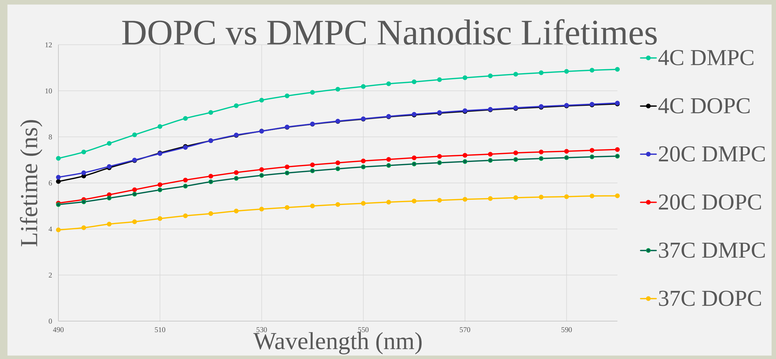
Lifetimes

- We use FLASC for a sample chamber, TimeHarp to acquire data and FluoFit to analyze the data.
- Excited at vertical angle, the intensity decay is detected at magic angle (54.7°). This eliminates contributions to the intensity decay that could be due to molecular rotation.

Intensity Decay Data

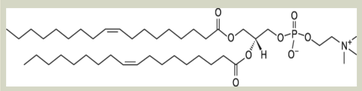




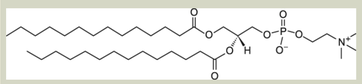


Lipids Used

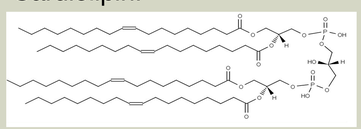
DOPC



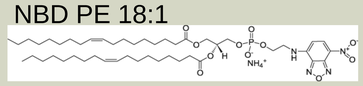
DMPC



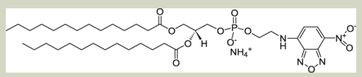
Cardiolipin:



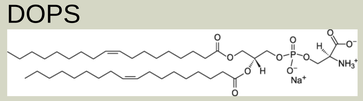
NBD PE 18:1

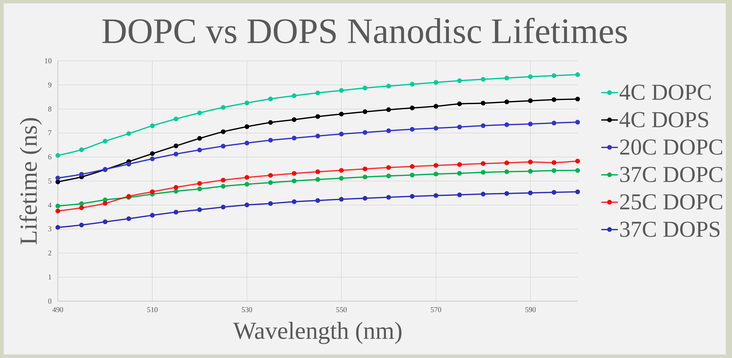


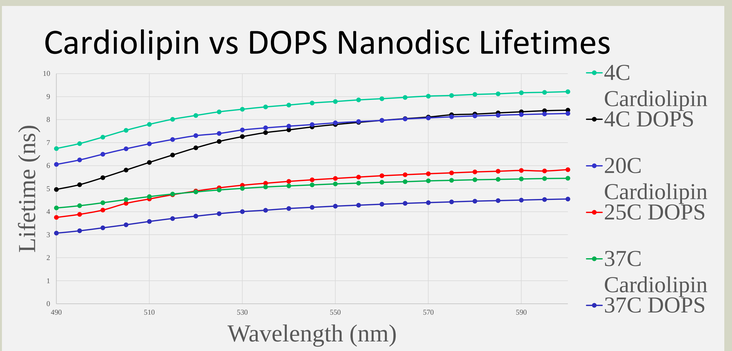
NBD PE 14:0



DOPS







Results, Conclusions and Implications

- Lifetimes decrease as temperature increases
  -nearby interactions increase, thereby increasing the rate of nonradiative decay. In this context, the interactions help the fluorescent lipids release energy, thus reflecting faster relaxation rates at higher temperatures.
- The probes in liposomes have longer lifetimes than in nanodiscs.
- Lifetimes increase as wavelength increases.
- Lipids with unsaturated tails have longer lifetimes.
- The probes in charged environments have shorter lifetimes.

Future Directions

- Then we will look at TRES, which shows the change in the spectra with respect to wavelength and time, which will reflect solvent relaxation, fluidity, electrostatics and other non-radiative processes.

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Acknowledgments

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